which had lain dormant in Osaka the preceding year, there being no trace of a fresh introduction. Osaka, in the autumn of the preceding year, had been invaded by the disease from Nagasaki; but after some thirty days of prevalence the epidemic gradually declined with the approach of the colder season, though it did not then entirely disappear. One or two cases kept occurring continually over into the next year, until, on the 2d of January, there were five cases reported in the western and southern districts of the city and in the ku of Sakai. On the 3d, five more cases were reported in the three ku of the west, south, and north, and the ku of Sakai. From this time forward, the number of cases gradually increased until the approach of the warmer season, toward the end of April, when it had spread all over the city, where it raged up to the end of October. During the epidemic, there were ninety-nine days in which the daily number of cases reported was over one hundred, and four days when there were two hundred. Indeed, it was the most severe epidemic ever known in Osaka.

"The situation of Osaka is such that it undoubtedly favors the propagation of an epidemic; for the water of the Yodo River, being conducted through the city by canals in various directions, besides furnishing a convenient roadway for transportation and water traffic, also receives the contents of the drains of the city, while at the same time it supplies the city with drinking-water.

"The wells, keeping the same level with the canals, freely communicate with each other, and thus the drinking-water of the city is more or less mingled with the water of the drains. Such, then, being the situation of Osaka, when an epidemic appears, the same convenience for the transportation of goods furnishes an easy medium for the propagation of disease. It is not strange, then, that since the tenth year of Meiji (1877), whenever an epidemic prevails, the city has been a centre of the epidemic. Moreover, in the preceding year there was much rain after the spring, until finally, in June, the Yodo River overflowed its banks, inundating the streets and houses. Hence the city was rendered very filthy, in consequence of which the concealed germs found a favorable nidus, from which the disease appeared with the return of the warm weather, and finally ravaged the whole city. It is also to be borne in mind, that, as Osaka is the commercial centre of Japan, and has free communication in every direction, it is likely to become the cradle of epidemics, and therefore whatever has made its appearance in various other localities has had its origin directly or indirectly in Osaka."

Drunkenness as a Disease.

Dr. Godding, superintendent of the Government Insane-Asylum in Washington, has written a letter to one of the committees of Congress, in which, while showing that it would be unwise to confine inebriates with insane persons, he makes the following interesting remarks: —

"Inebriety as a disease is distinct from insanity. Inebriates resent being placed with the insane; nor are the insane, as a rule, proud of them as associates. Insane from the poison of drink, as they undoubtedly are while the liquor is in them, they now and then get committed to hospitals for the insane, and in their detention during convalescence they afford interesting though unprofitable psychological studies. Dissolute in habit, and idle in life, they are uncomfortable from the start. They are usually fault-finding and impatient at their detention, denouncing every body and every thing about them. When quiet and seemingly at ease in their lot, they are studying how to smuggle in whiskey, or effect an escape. In them moral honesty and generous impulses are sadly wanting, and a condition of settled discontent characterizes the enforced abstinence of their hospital life. What they need is occupation and prolonged treatment in an industrial home, where they can be kept at work at enforced labor under the supervision of a judicious physician. As a rule, confinement in idleness does them little or no good."

The Vacuum Air-Ship again.

The House Committee on Ventilation and Acoustics recommends the passage of the bill, referred to in *Science* recently, making an appropriation to build a vacuum air-ship. The conditions of the grant of seventy-five thousand dollars are, that a like sum shall already have been spent upon the construction of the air-ship, and that the secretary of the navy, after an investigation, with the aid of a board of engineers, into the plan of the construction of the proposed air-ship, and into the principle upon which it is proposed practically to operate it, shall be satisfied that there is reason to believe the air-ship will prove a success in attaining the ends for which it was designed. The last payment is to be made after a successful trial trip has been made. Dr. A. de Bausset, the inventor of this vacuum air-ship, proposes to make it in the form of a tube, air-tight, and cone-shaped at the ends, of steel of sufficient strength to withstand the pressure of the circumambient air when a vacuum has been produced by pumping all the inside air out of the ship. He says of his plan, "Steel $\frac{1}{44}$ of an inch in thickness has been tested, and has been proven capable of sustaining a pressure double that of the atmosphere. A cylinder 46 yards in diameter, with a total length of 218 yards, if made of this steel, will weigh 260,680 pounds: the volume of air contained in it weighs 719,709 pounds, giving an ascensional force of 459,029 pounds if the vacuum were complete." He relies upon an electric motor and a compound exhaust-screw to propel and guide the vessel when afloat.

Mr. George W. Melville, chief of the Bureau of Steam-Engineering, of the Navy Department, has written to Dr. de Bausset as follows: "I have the honor to inform you that I have looked over many of your computations, and find them correct, and also that the principle and theory of your aeroplane are in the main correct; but I have not sufficient time to properly study the details of construction of the vessel, which would be necessary in order to pass judgment upon it."

ELECTRICAL SCIENCE.

Tests of the Tudor Accumulator.

PROFESSOR KOHLRAUSCH has carried out some experiments on the Tudor accumulator which are not uninteresting. The following is part of the data obtained: —

Weight of plates	29.3 lbs.
Surface of four positive plates	1.29 sq. ft.
Volume of acid	6 pts.
Specific gravity, charged	1.147
Normal charge rate	5 ampères
Normal discharge rate	6.5 "
Internal resistance, charged	.015 ohms
" " discharged	.02 "
Capacity per pound	1.6 ampère-hours

The two cells that were tested had been in continuous use from November, 1881, to December, 1887. During the tests they were charged and discharged thirty-four times, and between charge and discharge a period of fifteen hours was allowed to elapse. Six experiments showed a total capacity of 47 ampère-hours, an efficiency of 82.4 per cent for energy, with a drop of 12.6 per cent in electro-motive force. After this several tests of an abnormal character were made. The cells were charged, and then left alone for various periods of time. There was a loss of about 7 ampère-hours at first, but after this there was no further loss in a week. When charged with a current of 8 ampères, and discharged at 10 ampères, the total efficiency was 64.7 per cent. When discharged through a constant resistance, with a current beginning at 50 ampères, they gave 23.5 ampère-hours and 40.5 watt-hours; the current falling from 50 ampères at the start to 40 ampères at the close, and the electro-motive force from 1.8 volts to 1.3 volts. They were then recharged, and discharged with 90 ampères at the commencement and 62 ampères at the end. After this enormous strain, the cells, when recharged, gave their normal discharge just as at first.

Lastly, they were run down for four days, starting at 1 ampère, until the electro-motive force had fallen to 0.2 volts, and the specific gravity of the acid to 1.1. The cells were then recharged, and on discharge gave 46.8 ampère-hours, with a total efficiency of 80 per cent. The tests show a length of life of the cell, and a power of resisting abnormal discharge and discharge rates, that is in advance of any thing yet recorded. The storage capacity is, however, low as compared with more recent cells. As, however, it is in length of life and the allowing of heavy discharge rate that the ordinary battery is mainly deficient, these experiments encourage us to believe that in a few more years storage-batteries will have reached the point where their application to traction in cities will be almost

universal, and where they will make the distribution of electricity for lighting on a large scale better able to compete in price with gas.

THE MAGNETIZATION OF WATCHES. — With the rapid introduction of dynamo-electric machines and electric motors, there has arisen an inconvenience that is not only felt by those who work in electric-lighting stations, but which is likely to affect the public generally. Steel is usually used in the quick-moving parts of watches; and when this, for any reason, gets in a strong magnetic field, it becomes magnetized, greatly changing the rate of the watch, and making it irregular. It is possible to demagnetize a watch that is affected in this way; but it is a troublesome process, and is not a permanent safeguard. To avoid this trouble, non-magnetic balances are being rapidly introduced; and, although those made at present are more costly than steel, yet they add but little to the total cost of the watch, and make it reliable under all conditions. Probably the first to make an alloy that would possess the properties of hardness and elasticity without being magnetic, was Paillard. He has described several alloys that may be used; and watches made with balance-wheels and hair springs of these alloys have stood the most severe tests, with success. The most important component in the alloys is palladium. The other components are copper and iron, for one of the alloys; viz.: —

Palladium	50 to 75 parts
Copper	20 " 30 "
Iron	5 " 20 "

Another alloy is, —

Palladium	65 to 75 parts
Copper	15 " 25 "
Nickel	1 " 5 "
Gold	1 " 2½ "
Platinum	½ " 2 "
Silver	2 " 10 "
Steel	1 " 5 "

These alloys, especially the latter, are almost free from magnetic properties. Balances that are to be compensated for temperature are either made of two segments of alloys of different compositions, having different rates of expansion; or the segments are one of alloy, the other of silver. Since attention has been called to Paillard's methods, quite a number of manufacturers in this country and England have experimented on the subject, and are now making non-magnetic watches; and it is probable that at an early day the majority of the watches sold will be made to resist the action of magnetic fields.

CONDUCTIVITY OF A VACUUM. — M. Foeppl has experimented on the conductivity of a vacuum by an ingenious method. He made an induction-coil whose secondary circuit consisted of a glass tube 7 millimetres external diameter, 4.2 millimetres internal diameter. The ends of this coil were connected to a second coil so arranged as to form a galvanometer, within which was a magnet suspended by a cocoon-fibre. The glass tube forming the secondary circuit was coiled in two layers of 18 turns: the primary coil was 24 centimetres long, and was composed of twelve layers of seventy-two turns of wire. With a current of 22 ampères in the primary, making and breaking the circuit, M. Foeppl could not discover any deflection of the needle when there was a vacuum in the secondary tube, even when the degree of rarefaction was changed through a somewhat wide range. He calculates from his experiments that the resistance of such vacuums as he used could not be less than 3×10^6 times that of pure copper. This experiment bears directly on the question as to whether a perfect vacuum would be a perfect conductor or a perfect insulator, since the effect of the electrodes used to introduce the current into vacuum tubes is avoided. While it has, to within a short time, been admitted that a tube in which there is a very perfect vacuum will not admit the passage of electricity, it has been held by some that the result is due to an enormous resistance at the surface of the electrodes, not in the vacuum itself. This experiment disproves this view; at least, for the degrees of rarefaction employed. The wonderful influence of light on electric discharges that is being now investigated by so many experimenters would possibly have influenced the results of M. Foeppl's experiments, if they had been tried in the presence of some intense source of light.

WINDMILLS FOR ELECTRIC-LIGHTING. — Some time ago the possibilities of windmills for domestic electric-lighting were mentioned in this journal, and lately the experiment has been practically tried. Professor Blyth read before the Glasgow Philosophical Society a paper on the subject, in which he describes an experiment which he made last summer, — the lighting of a cottage in which he spent his vacation by a dynamo driven by a windmill, and charging a storage-battery. The windmill used was an old-fashioned type, with four arms at right angles to each other, each of them thirteen feet long. There was no especial regulating-device. The dynamo was belted directly to the fly-wheel of the mill, and charged twelve cells of storage-battery which supplied the incandescent lamps in the cottage. Professor Blyth had never used more than ten lamps at once, but he could have used more. With a good breeze, enough electricity could be stored in half a day to supply light for four evenings of three or four hours each. The lamps used were of 8-candle power. When charging, the current passed through a cut-out that would disconnect them from the dynamo when it ran below a certain speed: so the windmill could be allowed to run all the time, charging the battery when the wind happened to be strong enough. The current had been used to run a light turning-lathe, and Professor Blyth had begun to make a light carriage to be run by the stored electricity. The paper opens to us a field for ingenuity, comfort, and amusement in our homes. Windmills much superior to that described can be readily purchased, a small dynamo can be bought or built at little cost, and storage-batteries can be purchased or made. With them we could light our house economically; our light would be better, cooler, and healthier than gas or coal-oil lamps; while the current could be utilized for running fans, sewing-machines, etc. Indeed, to the average American, with some spare time and some small ingenuity, the amusement and instruction of such a plant would more than pay for its expense.

HEALTH MATTERS.

Cremation of Garbage.

THE important subject of garbage-cremation, and the recent advances made in this method of disposing of this waste material, are admirably summed up in the following extract from the *Sanitary News*: —

An indorsement of the method of disposing of kitchen waste, recently inaugurated in Chicago, was pronounced before the section on State medicine at the Cincinnati meeting of the American Medical Association, Tuesday, May 8, by Dr. J. Berrien Lindsley of Nashville, Tenn. Dr. Lindsley's paper was an exhaustive *résumé* of the present status of garbage-cremation. He gave two or three examples showing the great quantity and variety of polluting material occurring without pause in the limits of a city.

Baltimore, August, 1887, estimated by police census, had a population of 437,155. The amount of night-soil delivered at the dumps for the year ending Dec. 31, 1887, was 51,107 loads, or 10,221,400 gallons. Probably more than half the inhabitants use water-closets which carry off an equal amount.

The dead animals, etc., removed during the same year, were: —

Total number of dead animals	25,249
" " " fowls	9,079
" " " fish	23,574
" " cart-loads of dead fish, vegetable and other offal removed from various docks	1,067
" " pounds of decayed meat condemned	1,495
" " dozens of eggs condemned	607

Richmond, population 100,000. The report of contractor for removal of garbage or kitchen refuse, year 1887, shows total number of loads carried off 2,680, equal to 72,200 bushels.

Memphis, population 62,335. Number of loads of garbage removed in 1887 was 29,120.

These examples were selected at random. To keep the city clean is the principal work of municipal governments, and requires more expenditure of money than all other objects combined, excepting schools and police.

The city filth naturally falls into four main subdivisions, — street-sweepings, night-soil, dead animals, and garbage. The latter alone concerns us at present. The definition of garbage is refuse